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17.0 FAULT CROSSINGS

17.1 INTRODUCTION

This section contains the criteria to be used in establishing the design of the pipeline when crossing an active geologic fault or fault zone.

17.2 CODES AND CRITERIA

17.2.1 Codes

- Code of Federal Regulations (CFR)
  - Title 49, Transportation, Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
  - Title 18 – Conservation of Power and Water Resources
- Federal Right-of-Way Grant for the Alaska Natural Gas Transportation System Alaska Segment, Serial No. F-24538 (December 1, 1980), as such may be updated and/or amended from time to time
- Federal Energy Regulatory Commission conditional certificate of public convenience and necessity, issued on December 16, 1977, as such is finalized

17.2.2 Criteria

- ANNGTC will provide the necessary studies and data to ensure that all recognizable or reasonably inferred faults or fault zones along the alignment have been identified and delineated and the risk of major pipeline damage resulting from fault movement and ground deformation has been adequately assessed and provided for in the design.
- Only faults or fault zones interpreted by the ANNGTC or its agent as being active will receive special design consideration.
- As per the Federal Right-of-Way grant, paragraph 3.2.2.2, the pipeline will be designed to resist failure resulting in pipe rupture from maximum anticipated horizontal and/or vertical displacement in the foundation material anywhere within the fault zone during the life of the gas pipeline.
- Construction modes for fault crossing will be selected according to the criteria in Section 13 unless site-specific designs are required.
- As per the Federal Right-of-Way grant, paragraph 3.2.1.2, an approved seismic monitoring system will be provided.
- As per the Federal Right-of-Way grant, paragraph 3.2.1.2, operational procedures will be incorporated into the Operations Plan for the pipeline to ensure safe shutdown of

the pipeline under seismic conditions that may affect pipeline integrity. The procedures will include:

- Communications capability with all key operating control points on the pipeline system, the gas processing plant, and other parties with seismic monitoring capabilities, as appropriate;
- A control center and alternate for the pipeline system;
- Operating procedures establishing the actions to be taken in the event of seismic conditions that may affect pipeline integrity;
- Seismic sensors as necessary to supplement existing monitoring capabilities.

- As per the Federal Right-of-Way grant, paragraph 3.2.1.2, no storage tank or compressor station will be located within an active fault zone unless otherwise approved.
- Regular inspection of the fault crossing will be incorporated into the line patrol philosophy

17.3 DESIGN PROCEDURES

17.3.1 Fault Identification

The program to identify faults that may be crossed by the gas pipeline and may demonstrate the possibility of surface rupture during the design life of the pipeline will include the following elements:

- The program will utilize best practical technology to allow a thorough assessment of the following fault parameters:
  - Fault crossing location
  - Fault width
  - Fault geometry
  - Fault displacement per event
  - Fault length
  - Surface rupture length
  - Earthquake magnitude
  - Ground motions during design earthquakes
  - Design earthquake recurrence interval
  - Fault type
- The program will include geologic and geophysical investigations such as:
  - Review relevant literature, data and ongoing research and field programs.

- Conduct discussions with experts in the area such as the Alaska Geological and Geophysical Survey, University of Alaska, U.S. Geological Survey, Canadian Geological and Geophysical Agencies personnel and private consultants.
- Analyze relevant satellite, infrared and conventional air-photo imagery.
- Analyze relevant seismic and earthquake data.
- Analyze the geology and geomorphology of the area. Prepare preliminary maps.
- Conduct a field reconnaissance; both aerial and on-ground.
- Prepare a complete field program plan.

- The Field Program will include:
  - Compiling geologic and geomorphic maps from aerial and ground work.
  - Gather appropriate earth materials for age-dating by applicable methods.
  - Conduct geophysical surveys, if determined necessary.
  - Conduct trenching across faults or fault zones, if determined necessary.
- Fault crossing data will be compiled and analyzed, and conclusions and recommendations will be made and documented in a report for Notice to Proceed.

17.3.2 Design Aspects

Should it be determined that the gas pipeline will cross an active fault zone (or zones), then the following design considerations will apply.

- If structural analysis indicates that standard design pipeline will safely withstand the magnitude of fault displacement across a fault zone, then the standard pipeline construction modes described in Section 13 will be used.
- If structural analysis indicates that the standard pipeline design will not safely withstand the magnitude of fault displacement across a fault zone then site-specific design will be necessary.
  - Site specific designs may include engineering measures such as: increased pipe wall thickness, increased toughness, modified weld requirements, modified back fill approaches, burial in above-grade embankments; aboveground and unrestrained moding on grade beams pile supports; or nonstandard buried configurations.
  - The design will take into consideration predicted displacements, predicted ground motion, surface topography, width of fault or fault zones, soil conditions, erosion and drainage control, environmental impact, proximity of third party structures, and relative costs.

17.3.3 Monitoring

The gas pipeline will be monitored for displacement and leaks during normal ground and or aerial patrol. Periodic inspections, where required, will also include changes in pipe curvature and excessive pipe wall deformation.

17.3.3.1 Seismic Monitoring

A seismic monitoring system will be installed in accordance with the federal Right-of-Way grant stipulated requirements. Seismic sensors will detect earthquakes, and the signals will be transmitted to compressor stations or the Operations Control Center for action, if required. Seismic monitoring will be outlined in an Operation and Maintenance Plan.

17.3.3.2 Fault Crossing - Response Plan

An Operation and Maintenance Plan will be prepared that will address necessary actions and precautions during and after earthquakes on the faults, and the potential damage repair and restoration procedures and logistics.

17.3.3.3 Pipe Monitoring

A pipeline monitoring program will be implemented during the pipeline start-up, which will detect changes in pipe curvature and/or excessive pipe wall deformation.